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# THE MARINE AND BRACKISH WATER SPECIES OF *VAUCHERIA* (TRIBOPHYCEAE, CHRYSOPHYTA) FROM CONNECTICUT

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## ABSTRACT

A more than decade-long field investigation of the genus *Vaucheria* in Connecticut salt marshes and estuarine habitats has revealed the presence of nine species, including five species and a variety not previously known for the area: *V. arcassonensis, V. compacta* var. *koksoakensis, V. coronata, V. intermedia, V. minuta,* and *V. nasuta.* Culture conditions in the laboratory stimulated production of gametangia, allowing for identification of mostly vegetative field-collected samples in their native muds. All marine and brackish water species of *Vaucheria* previously reported from other parts of New England are now known from Long Island Sound.

Key Words: *Vaucheria,* Vaucheriaceae, Tribophyceae, Long Island Sound, Connecticut

## INTRODUCTION

In his comprehensive flora of the green algae of North America, F. S. Collins (1909) included the then poorly known family Vaucheriaceae, listing just three marine species of *Vaucheria* from New England. Since that time, a number of studies has greatly increased our understanding of the family, culminating in the publication of a seminal monograph on the North American Vaucheriaceae by J. L. Blum (1972). This work prompted regional marine studies of *Vaucheria* in localities on the continent where the genus was poorly known, including Ott and Hommersand (1974) in North Carolina, Bird et al. (1976) in Nova Scotia, Pecora (1976, 1977, 1978, 1980) in Louisiana and Texas, Gallagher and Humm (1981) on the Florida Gulf coast and Garbary and Fitch (1984) in British Columbia and Washington. However, areas remain in North America, including much of New England, where the genus has not been investigated systematically. When compiling the list of seaweeds for Connecticut (Schneider et al., 1979), the first author recognized the paucity of species records in the

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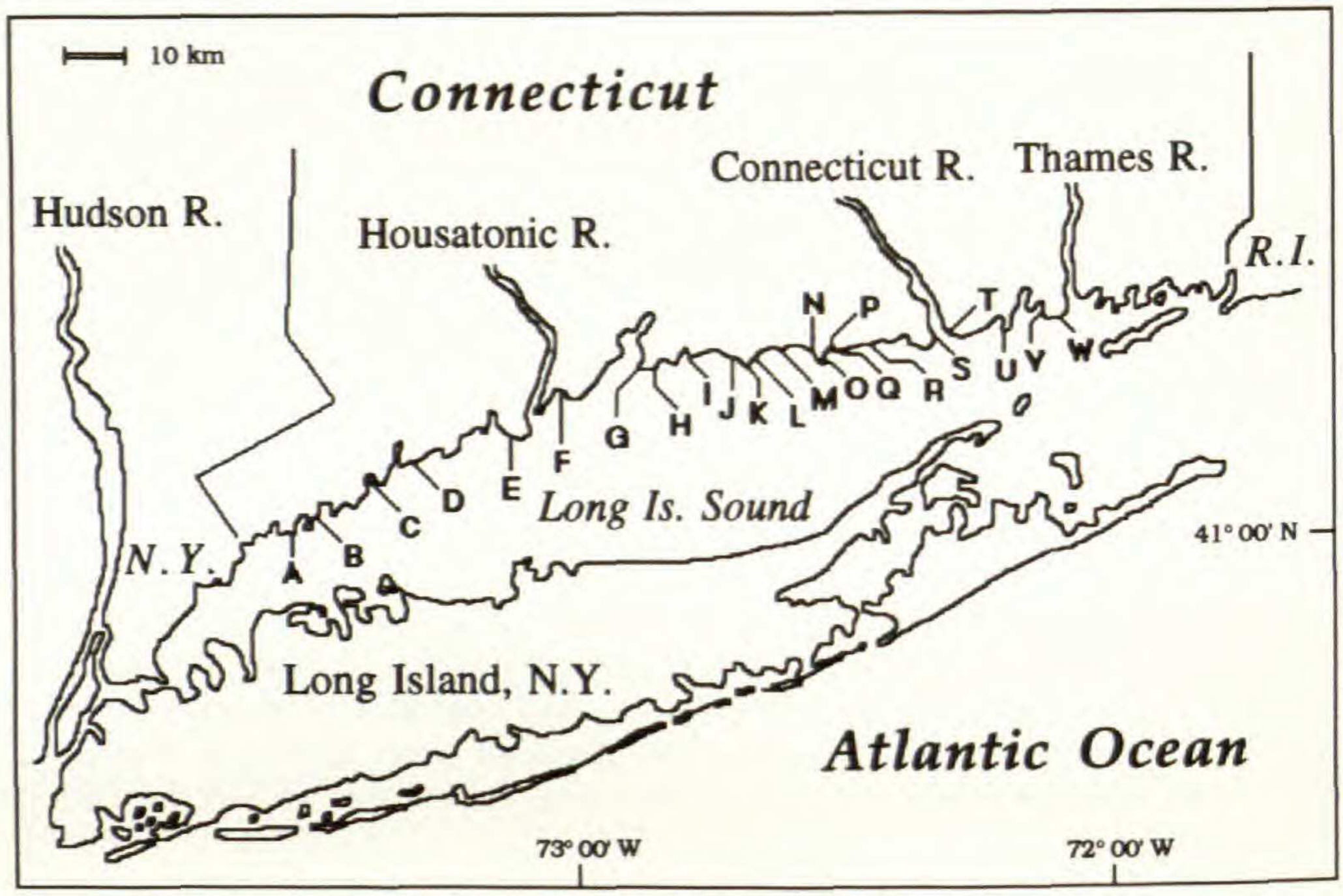


Figure 1. Map of the study area. For specific collecting site codes, see Table 1.

state relative to other areas in New England, in particular Massachusetts, and initiated the study reported here. At the time, only four marine species of *Vaucheria* had been reported from Connecticut: *V. compacta* (Collins) Collins ex W. R. Taylor (as *V. piloboloides*), *V. litorea* C. Agardh, *V. velutina* C. Agardh (as *V. thuretii*, Collins, 1900), and *V. vipera* Blum (Collins, 1900; Blum, 1972).

In part, the relatively small number of species known at that time for Connecticut, a state with a 160 km coastline divided by dozens of rivers and streams entering Long Island Sound, reflected the few collections made in the area. Furthermore, most collections were taken in the drier summer season, not during the autumn-winter-spring period of optimal growth and reproductive conditions for most *Vaucheria* species (Blum and Conover, 1953; Blum, 1966). Although *Vaucheria* is a common constituent of salt marsh and estuarine muds, it is most often found in the vegetative state, thereby proving impossible to distinguish at the species level. Previous workers (e.g., Ott and Hommersand, 1974; Pecora, 1976) found that suitable laboratory culture conditions would first allow luxuriant vegetative growth from the mud platform and then gametangial production, giving a more complete floristic assessment of *Vaucheria* species within a habitat.

Table 1. Long Island Sound collection sites.

| | |
|---|---|
| A | Fairfield Co., Greenwich Point Park salt marsh, Greenwich (GPP) |
| B | Fairfield Co., Cove Island Park salt marsh, Stamford (CIP) |
| C | Fairfield Co., mouth of Silvermine River, east bank, East Norwalk (SLV) |
| D | Fairfield Co., Sherwood Island State Park salt marsh, Westport (SHI) |
| E | Fairfield Co., Pride's Point, tidal channel vic. Housatonic River, Stratford (PPS) |
| F | New Haven Co., Milford Point salt marsh, Milford Harbor, Milford (MLH) |
| G | New Haven Co., Morris Creek salt marsh, Lighthouse Point, East Haven (MOR) |
| H | New Haven Co., Mansfield Point salt marsh, East Haven (MNS) |
| I | New Haven Co., Indian Neck Inlet salt marsh, Branford (INI) |
| J | New Haven Co., Island Bay salt marsh, Leetes Island, Guilford (LTS) |
| K | New Haven Co., Joshua Cove salt marsh, Sachem Head, Guilford (JCV) |
| L | New Haven Co., Chaffinch salt marsh, Guilford Harbor (CGH) |
| M | New Haven Co., Seaview Beach salt marsh, Madison (SVM) |
| N | New Haven Co., Hammonasett State Park salt marsh, Madison (HSP) |
| O | Middlesex Co., Meig's Point salt marsh, mouth of Hammonasett River, Clinton (HRC) |
| P | Middlesex Co., mouth of Indian River, east bank, Clinton (IRC) |
| Q | Middlesex Co., Clinton Beach salt marsh, Clinton (CBC) |
| R | Middlesex Co., Menunketesuck River, river banks, Grove Beach (GRV) |
| S | New London Co., Saybrook Point salt marsh, Old Saybrook (OSP) |
| T | New London Co., Blackhall River, river banks, Old Lyme (BOL) |
| U | New London Co., Rocky Neck State Park salt marsh, East Lyme (RNS) |
| V | New London Co., Pleasure Beach salt marsh, Waterford (PBW) |
| W | New London Co., Harkness Memorial State Park salt marsh, Waterford (HMW) |

## MATERIALS AND METHODS

Since the initiation of this study in 1980, we have visited more than 20 salt marsh and estuarine habitats along the Connecticut coast of Long Island Sound from Greenwich to New London (Figure 1), often revisiting the same sites in different seasons as well as years. The distance to collecting sites from Hartford accounted for the unevenness in visits to different sites. For example, we have taken nearly a hundred samples from over 20 visits to Harkness Memorial State Park, the most frequently visited salt marsh, but only visited the most distant locality, Greenwich Point Park, once. Few collections were made during summer, a period when typically high temperatures, high light intensities and lower rates of precipitation do not foster obvious growth of *Vaucheria* in Long Island Sound salt marshes.

Codes identifying the collecting sites are given in Table 1. At each collecting site in close proximity to a tidal channel or stand-

ing water, quadrats of mud 42.25 $cm^2$ and 2–3 cm thick (size compatible with culture vessels) with visible *Vaucheria* siphonous filaments or mats, were cut with a serrated knife and removed with a broad spatula. Mud samples without obvious *Vaucheria* were taken only when siphons could not be located within a given marsh. Vascular plants within the quadrat were cut off at mud level. Two to six mud samples were taken from different areas within each salt marsh or estuarine bank and transported back to the laboratory on ice.

In the laboratory, each sample was observed under the microscope for gametangia. Then, each sample was subdivided into quarters, placed into deep culture vessels and filled to one-half of the mud sample thickness with culture media. During the early years of the study, the divided crude cultures were placed in enriched seawater Grund medium (von Stosch, 1969) and then incubated in Hotpack No. 352642 growth chambers with set photoperiods of 8L:16D, 12L:12D or 16L:8D at 5° or 15°C temperatures. Because all of the collected species produced gametangia at least during the longest daylength and warmer temperature, beginning in 1987 we standardized culture conditions with a photoperiod 16L:8D, light intensity ca. 125 $\mu mol/m^2/sec.$, and temperatures of 15°C during the light cycle and 13°C in the dark cycle. We also varied the salinity in the crude cultures (0.3, 2.0, 4.0, 6.5, 16.0, 30.0 ppt) using modified ASP-V media (Entwisle, 1988). Additionally, mud cores of some of these cultures were subcultured into the same salinity media with 1.75% agar added. Agar cores were removed with a 0.5 cm cork borer and replaced with the same sized mud-*Vaucheria* core. The Petri dishes were sealed with Parafilm®. Microscopical observations on each crude and agar culture were made every three to four days. Drawings were made with the aid of a Zeiss camera lucida, and vouchers of each of the species are deposited in Herbarium C. W. Schneider at Trinity College, Hartford.

## RESULTS AND DISCUSSION

All nine species and one variety of *Vaucheria* presently reported from New England have been found in Connecticut marine and brackish water environments along Long Island Sound, with several of the species appearing together in the same small quadrat

of mud collected from a particular salt marsh or estuarine bank. Many of the mud samples taken without visible *Vaucheria* were found to produce siphons after incubation in culture media. Either siphons existed within the mud below grade, or dormant zygotes or asexual spores were coaxed into germinating under favorable culture conditions. Few of the crude cultures produced vegetative siphon growth without ultimately developing gametangia, and many cultures produced two to four species over time in a single quadrat. Several collecting sites, in particular those closest to large industrial cities such as Norwalk, Bridgeport, and New Haven, never produced *Vaucheria*; but on the whole, the genus is readily collected throughout the year and the coastal region of the state. None of the species presented characteristics which differ from Massachusetts populations, so the reader is referred to Blum (1972) or Christensen (1987) for descriptions including pertinent measurements. New records for Connecticut are noted with asterisks (*).

## VAUCHERIACEAE Dumortier 1822, p. 71

### *Vaucheria arcassonensis P. J. L. Dangeard 1939, p. 216.

Figures 2a, b

This species was previously known in New England only from Maine and Massachusetts (Blum and Conover, 1953; Webber, 1968). In Connecticut, it was one of the two most frequently encountered species. To the south, *Vaucheria arcassonensis* is the most abundant *Vaucheria* species in North Carolina (Ott and Hommersand, 1974), and despite extensive investigations in the Gulf of Mexico, it has been found only at a single locality in Wakulla Co., Florida (Pecora, 1980). We find *V. arcassonensis* throughout the state, fruiting during the winter-spring period, very commonly in the same samples with *V. coronata* and on occasion with *V. intermedia, V. minuta,* and *V. velutina.* Similarly, in the British Isles *V. arcassonensis* is generally mixed with *V. intermedia* and often associated with *V. coronata* and *V. velutina* (Christensen, 1987).

TYPE LOCALITY: France

DISTRIBUTION: Nova Scotia, New England, North Carolina, Florida Gulf coast, Europe, Australia.

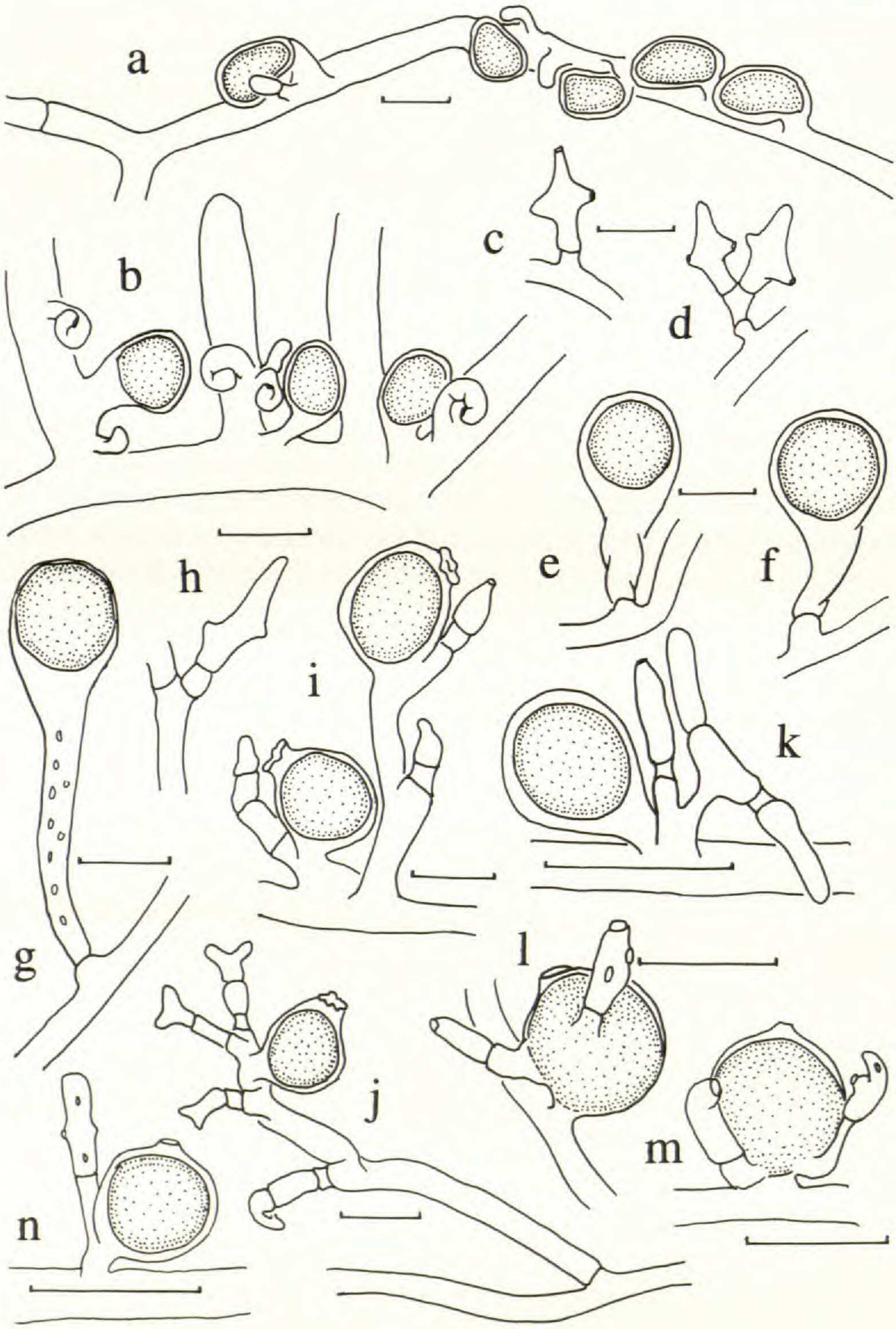


Figure 2. Connecticut marine and brackish water *Vaucheria* species, all scale bars = 100 μm: a–b. *V. arcassonensis*; a, JCV coll. Sept. 1982; b, HMW coll. Jan. 1992. c–f. *V. compacta*, OSP coll. Oct. 1991; c–d, antheridia, e–f, oogonia. g–h. *V. compacta* var. *koksaokensis*, BOL coll. Feb. 1981; g, oogonium; h, antheridium. i–j. *V. coronata*; i, HMW coll. Jan. 1992; j, PBW coll. Apr. 1983. k–n. *V. inter-*

COLLECTIONS: Fairfield Co.—23 Mar. 1981, **CIP**, *T. Roche,* fertile in culture 20 Apr. 1981; 23 Mar. 1981, **GPP**, *T. Roche,* fertile 8 Apr. 1981. New Haven Co.—23 Sept. 1982, **JCV**, *S. Heminway,* fertile 28 Feb. 1983; 3 Apr. 1983, **JCV**, *S. Heminway,* fertile 18 Apr. 1983; 1 Mar. 1992, **CGH**, *J. Cahill,* fertile in field. New London Co.—30 Nov. 1982, **PBW**, *S. Heminway,* fertile 20 Apr. 1983; 29 Jan. 1992, **HMW**, *L. MacDonald,* fertile 6 Feb. 1992; 27 Feb. 1992, **PBW**, *J. Cahill,* fertile 1 Mar. 1992; 17 Mar. 1992, **PBW**, *L. MacDonald,* fertile in field; 6 May 1992, **HMW**, *C. Schneider,* fertile 13 May 1992; 6 May 1992, **PBW**, *J. Cahill,* fertile 13 May 1992.

**VAUCHERIA COMPACTA** (Collins) Collins ex W. R. Taylor 1937, p. 226. Figures 2c–f

This species was previously reported in New England from Massachusetts (Blum and Conover, 1953; Webber, 1975) and Connecticut (as *Vaucheria piloboloides,* Collins 1900). We commonly found *V. compacta* in the same mud samples as *V. velutina* and occasionally with *V. intermedia* and *V. minuta.* In our cultures, *V. compacta* was fertile from 0.3–30 ppt salinity. This species is only known from very low salinity brackish water in Louisiana (2.2 ppt; Pecora, 1977), but elsewhere is found in higher salinity environments as well (Blum, 1972; Simons, 1974; Christensen, 1988).

TYPE LOCALITY: Massachusetts
DISTRIBUTION: Nova Scotia, New England, Louisiana, Europe.

COLLECTIONS: New Haven Co.—29 Sept. 1984, **CGH**, *P. Renaud,* fertile in culture 1 Mar. 1985. Middlesex Co.—5 Mar. 1987, **GRV**, *B. Bothwell,* fertile 4 Apr. 1987; 22 Sept. 1991, **GRV**, *J. Cahill,* fertile 1 Oct. 1991. New London Co.—19 Feb. 1981, **RNS**, *T. Roche,* fertile 11 June 1981; 18 Aug. 1984, **HMW**, *P. Renaud,* fertile 11 Sept. 1984; 29 Sept. 1984, **HMW**, *P. Renaud,* fertile 26 Oct. 1984; 28 Oct. 1984, **HMW**, *P. Renaud,* fertile 22 Jan. 1984; 15 Oct. 1991, **OSP**, *L. MacDonald,* fertile 2 Nov. 1991; 12 Sept. 1992, **HMW**, *H. Miller,* fertile 4 Nov. 1992.

***VAUCHERIA COMPACTA** var. **KOKSOAKENSIS** Blum et Wilce 1958, p. 286. Figures 2g, h

This variety was differentiated from the typical form of *Vaucheria compacta* due to its greatly elongated oogonia (Blum and Wilce,

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*media*; k, GRV coll. Sept. 1991; l–m, HMW coll. Oct. 1980; n, RNS coll. Oct. 1980.

1958). To date, we have discovered this taxon only along the muddy banks at the mouth of the Blackhall River in Old Lyme, a habitat physically if not environmentally similar to that of the type locality at the mouth of the Koksoak River near Ungava Bay. Only one previous collection of *V. compacta* var. *koksoakensis* has been reported for New England, that from an Ipswich, Massachusetts salt marsh (Webber, 1968), thus our record represents a new southern limit of distribution for the entity.

TYPE LOCALITY: Quebec
DISTRIBUTION: Eastern Canada, Massachusetts, Connecticut.

COLLECTION: New London Co.—18 Feb. 1981, **BOL**, *T. Roche,* fertile in culture 10 June 1981.

*VAUCHERIA CORONATA Nordstedt 1879, p. 177. Figures 2i, j

This species was previously known only from Maine and southern Massachusetts in New England, (Blum and Conover, 1953). We have collected this alga with its diagnostic "crowned oogonia" from several localities across the state, commonly in the same mud quadrats as *Vaucheria arcassonensis,* and occasionally with *V. intermedia* and *V. minuta.* It has been collected fertile in the field from March–May. Although it thrives in higher salinities (Christensen, 1988), at its southern-most habitat for North America in Louisiana, Pecora (1980) only found *V. coronata* in 3.0 ppt salinity.

TYPE LOCALITY: Sweden
DISTRIBUTION: Greenland, Nova Scotia, New England, Virginia, North Carolina, Louisiana, Europe.

COLLECTIONS: Fairfield Co.—23 Mar. 1981, **CIP**, *T. Roche,* fertile in culture 20 Apr. 1981. New Haven Co.—1 Mar. 1992, **CGH**, *J. Cahill,* fertile 13 Mar. 1992. New London Co.—30 Nov. 1982, **PBW**, *S. Heminway,* fertile 20 June 1983; 1 May 1983, **HMW**, *S. Heminway,* fertile in field; 29 Jan. 1992, **HMW**, *L. MacDonald,* fertile 19 Feb. 1991; 27 Feb. 1992, **PBW**, *L. MacDonald,* fertile 1 Mar. 1992; 17 Mar. 1992, **PBW**, *C. Schneider,* fertile in field.

*VAUCHERIA INTERMEDIA Nordstedt 1879, p. 179. Figures 2k–n

This alga has previously been collected from New England only in Massachusetts (Blum and Conover, 1953; Webber, 1968). We

have found *Vaucheria intermedia* only on the eastern half of the Connecticut coastline, from Grove Beach to Waterford, where it is often a dominant species, at times intermixed with *V. arcassonensis, V. coronata* and/or *V. velutina.* Blum and Conover (1953) found *V. intermedia* in a habitat with a known wide range of salinities in Massachusetts from fresh water to full-strength seawater.

TYPE LOCALITY: Sweden
DISTRIBUTION: Nova Scotia, New England, North Carolina, California, Washington, Europe.

COLLECTIONS: Middlesex Co.—22 Sept. 1991, **GRV**, *J. Cahill,* fertile in culture 7 Oct. 1991. New London Co.—2 Oct. 1980, **PBW**, *T. Roche,* fertile 16 Feb. 1981; 2 Oct. 1980, **RNS**, *T. Roche,* fertile 18 Feb. 1981; 18 Feb. 1981, **BOL**, *T. Roche,* fertile 10 June 1981; 19 Feb. 1981, **RNS**, *T. Roche,* fertile 11 June 1981; 30 Nov. 1982, **PBW**, *S. Heminway,* fertile 8 Dec. 1982; 12 Sept. 1992, **HMW**, *H. Miller,* fertile 4 Nov. 1992; 9 Dec. 1992, **PBW**, *B. Stockton,* fertile 22 Dec. 1992.

## VAUCHERIA LITOREA C. Agardh 1823, p. 463. Figures 3a–c

Although this species was previously reported for Connecticut as early as the turn of the century (Collins, 1900), we found *Vaucheria litorea* to be one of the more rarely collected species, only finding it within the last two years of the study in Saybrook Point salt marsh at the mouth of the Connecticut River. Here it was found in the same mud samples with *V. compacta* and *V. velutina.* In neighboring Rhode Island, only trace amounts of this alga were found in open ocean and estuarine habitats (Villalard-Bohnsack et al., 1988).

Along the Atlantic coast, *Vaucheria litorea* is established in salt marshes and brackish ponds (Blum, 1972; Ott and Hommersand, 1974), but in the Gulf of Mexico it is characteristic of low salinity areas and habitats that are only infrequently flooded with brackish water, areas with 1.0–2.6 ppt (Pecora, 1977).

TYPE LOCALITY: Denmark
DISTRIBUTION: Nova Scotia, New England, New York, New Jersey, North Carolina, Gulf of Mexico, Washington, Europe, Australia.

COLLECTION: New London Co—15 Oct. 1991, **OSP**, *L. MacDonald,* fertile in culture 2 Nov. 1991.

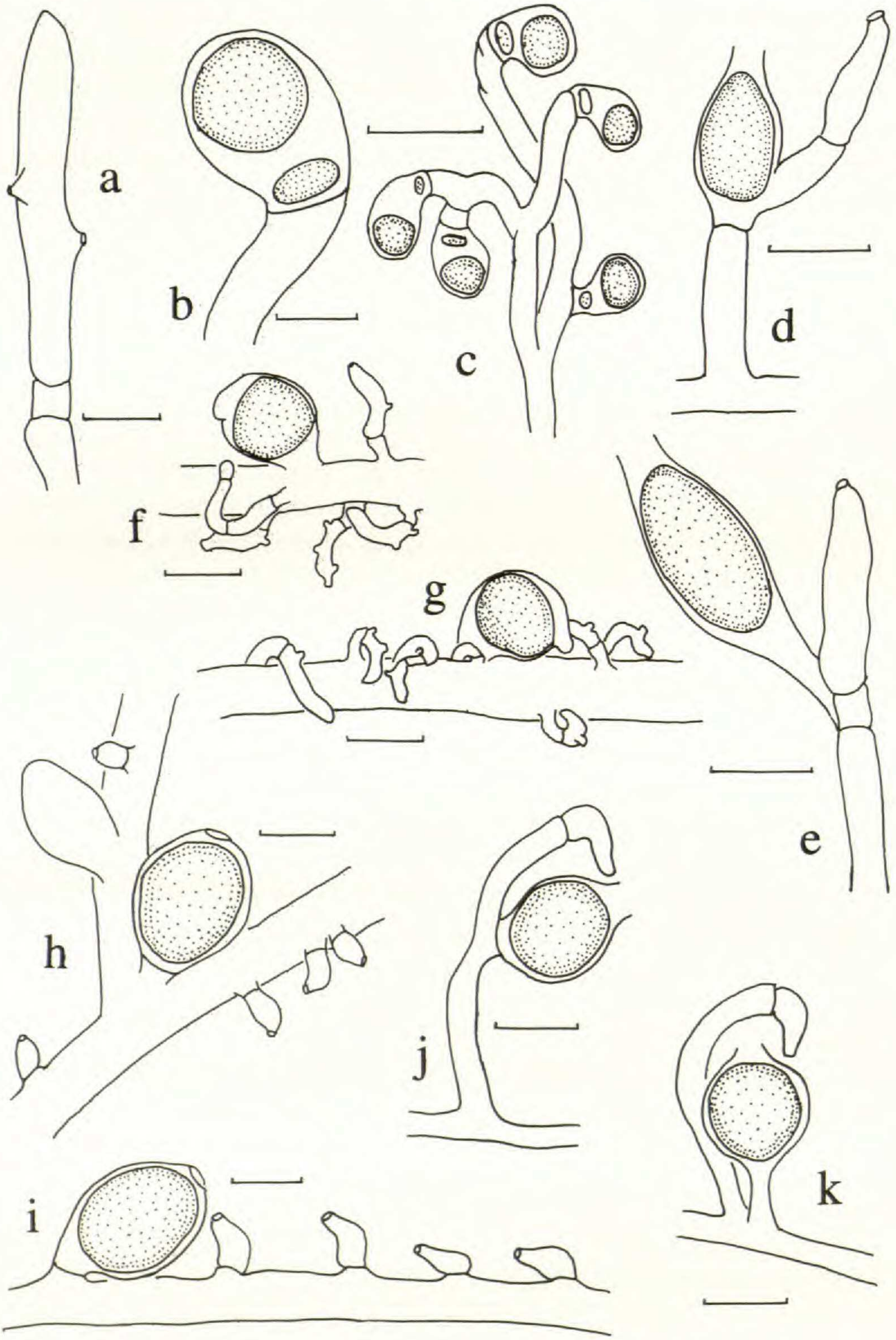


Figure 3. Connecticut marine and brackish water *Vaucheria* species, scale bars = 100 μm unless otherwise noted: a–c. *V. litorea,* OSP coll. Oct. 1991; a, antheridium; b–c, oogonia; c, scale = 500 μm. d–e. *V. minuta,* JCV coll. Sept. 1982, scales = 50 μm. f–g. *V. nasuta,* PBW coll. Feb. 1992. h–i. *V. velutina*; h, GRV

*VAUCHERIA MINUTA Blum et Conover 1953, p. 399.
Figures 3d, e

Originally described from Great Pond, Falmouth, Massachusetts, this alga was otherwise only known in New England from Maine (Blum and Conover, 1953; Webber, 1968). In Connecticut, we only infrequently found *Vaucheria minuta* along the eastern half of the coastline. Because of its small size, Ott and Hommersand (1974) suggested that this alga was perhaps overlooked and overshadowed by larger *Vaucheria* species in the same habitats. This could help account for the small number of collections in our study, as each collection of *V. minuta* in our mud quadrats was associated with *V. arcassonensis, V. compacta, V. coronota,* and/or *V. velutina.*

Blum and Conover (1953) discovered fruiting in a narrow range of natural marsh salinities 26–30.2 ppt. In culture, we found *Vaucheria minuta* with gametangia throughout the range of salinities tested, 0.3–30.0 ppt. Christensen (1988) had reported growth of this species in European populations between 2.5–40 ppt in liquid culture, with gametangia from 12.5–25 ppt. In that our cultures presumably included residual salts within the crude mud samples, we cannot state that the salinities in the muds from which our plants grow were in fact the same as the media applied to them (see following discussion on Salinity Culture Studies), thus fertility in the lowest salinity media may be misleading.

TYPE LOCALITY: Massachusetts
DISTRIBUTION: New England, North Carolina, Europe.

COLLECTIONS: New Haven Co.—23 Sept. 1982, **JCV**, *S. Heminway,* fertile in culture 2 Mar. 1983. New London Co.—29 Sept. 1984, **HMW**, *P. Renaud,* fertile 15 Apr. 1985; 29 Jan. 1992, **HMW**, *J. Cahill,* fertile 19 Feb. 1992; 6 May 1992, **HMW**, *C. Schneider,* fertile 13 May 1992.

*VAUCHERIA NASUTA W. R. Taylor et Bernatowicz 1952, p. 408.
Figures 3f, g

Prior to this study, *Vaucheria nasuta* was reported from New England only in Barnstable Marsh on Cape Cod (Bernatowicz,

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coll. Sept. 1991; i, RNS coll. Oct. 1980. j–k. *V. vipera,* JCV coll. Sept. 1982, scales = 25 μm.

1958) and two sites in Gloucester, Massachusetts (Webber, 1976). Webber (1976) found this species growing on the *Spartina* leaf litter at the separation of the lower and upper salt marsh. We found this species in one salt marsh; a small, protected habitat along the bank of a tidal channel behind Pleasure Beach, Waterford, underneath *Spartina* and intermixed with populations of *V. arcassonensis, V. coronata,* and *V. velutina* in the same mud quadrat. Although *V. nasuta* is apparently uncommon in New England, it is the second most abundant species along the North Carolina coast after *V. arcassonensis* (Ott and Hommersand, 1974). Blum reported this alga from California in 1971, the only known non-Atlantic Ocean site.

TYPE LOCALITY: Bermuda
DISTRIBUTION: New England, North and South Carolina, Bermuda, Gulf of Mexico, California.

COLLECTIONS: New London Co.—27 Feb. 1992, **PBW**, *J. Cahill,* fertile in culture 1 Mar. 1992; 17 Mar. 1992, **PBW**, *L. MacDonald,* fertile in field.

**VAUCHERIA VELUTINA** C. Agardh 1824, p. 312. Figures 3h, i

In New England, this alga is known from all of the coastal states except New Hampshire (as *Vaucheria thuretii,* Farlow, 1881; Collins, 1900; Blum, 1972; Villalard-Bohnsack et al., 1988). *V. velutina* is widespread in North America and the most commonly encountered species in the Gulf of Mexico, where it grows in salinities from 2–35 ppt (Pecora, 1977, 1980). In Connecticut, we also find it more frequently in salt marshes throughout the state than any other *Vaucheria* species, and at the full range of salinities tested. *V. velutina* was nearly always found growing in the same mud quadrats with *V. compacta,* and also with all of the other species except *V. litorea,* thus paralleling intrageneric associations in Europe (Christensen, 1987).

TYPE LOCALITY: France
DISTRIBUTION: New Brunswick, New England, New Jersey, North Carolina, Florida, Gulf of Mexico, Washington, British Columbia, Iceland, Europe, West Africa, Indian Ocean, Asia, Hawaii, Australia.

COLLECTIONS: Fairfield Co.—23 Feb. 1985, **SHI**, *P. Renaud,* fertile in culture 30 Apr. 1985. New Haven Co.—23 Sept. 1982, **JCV**, *S. Heminway,* fertile 11 Oct.

1982; 29 Sept. 1984, **CGH**, *P. Renaud,* fertile 29 Jan. 1985; 5 Mar. 1987, **SVM**, *B. Bothwell,* fertile 12 Mar. 1987; 1 Mar. 1992, **CGH**, *L. MacDonald,* fertile 17 Mar. 1992. Middlesex Co.—5 Mar. 1987, **IRC**, *B. Bothwell,* fertile 4 Apr. 1987; 5 Mar. 1987, **GRV**, *B. Bothwell,* fertile 4 Apr. 1987; 22 Sept. 1991, **GRV**, *J. Cahill,* fertile 1 Oct. 1991; New London Co.—2 Oct. 1980, **HMW**, *T. Roche,* fertile 10 Mar. 1981; 2 Oct. 1980, **RNS**, *T. Roche,* fertile 18 Nov. 1980; 18 Aug. 1984, **HMW**, *P. Renaud,* fertile 7 Sept. 1984; 29 Sept. 1984, **HMW**, *P. Renaud,* fertile 5 Oct. 1984; 3 Mar. 1987, **HMW**, *B. Bothwell,* fertile 4 Apr. 1987; 27 Feb. 1992, **PBW**, *J. Cahill,* fertile 19 Mar. 1992; 12 Sept. 1992, **RNS**, *B. Stockton,* fertile 21 Sept. 1992.

VAUCHERIA VIPERA Blum 1960, p. 298. Figures 3j, k

Previously reported from Bridgeport, Connecticut along with the type collection from Barnstable Harbor, Cape Cod and South Essex, Mass. (Blum, 1960), *Vaucheria vipera* has not been reported since in North America, although it has been discovered in Europe and Asia (Simons and Vroman, 1968). We collected it only once, in a salt marsh off Trolley Road, Sachem Head at Joshua Cove, Guilford, from the high intertidal banks of the tidal inlet approximately 17 m from the cove on compacted sediment covered with cyanobacteria and sparse *Spartina.* This habitat would have been inundated at high tide with full-salinity seawater, especially during times of low precipitation. Blum (1960) found this delicate species mixed with either *V. compacta* and *V. velutina* (as *V. thuretii*) and the Joshua Cove population shares its habitat with *V. minuta* and *V. velutina.*

TYPE LOCALITY: Massachusetts
DISTRIBUTION: New England, Europe, Japan, Hong Kong.

COLLECTION: New Haven Co.—23 Sept. 1982, **JCV**, *S. Heminway,* fertile in culture 8 Oct. 1982.

## SALINITY CULTURE STUDIES

All of the mud quadrats collected within the last two years were subdivided and cultured in media with salinities of 0.3, 2.0, 4.0, 6.5, 16.0, and 30.0 ppt. Because the technique consisted of placing estuarine mud samples in culture vessells and then subjecting them to culture media with various salinities, the effective salinity of a culture did not take into account the native salts within each mud sample. Nevertheless, the wide range in salinity of the media

into which the mud was inoculated was expected to account for some differences in a particular species' ability to reproduce. Although some species from local populations indeed did not produce gametangia in culture at all salinities, at least one population of *Vaucheria arcassonensis, V. compacta, V. litorea, V. nasuta,* and *V. velutina* was found reproductive in all of the salinity media. Although they produced gametangia during the earlier years of the study in the enriched seawater Grund medium, *V. coronata* and *V. intermedia* were never identified in the 30.0 ppt salinity ASP-V medium despite producing abundant reproductive structures in subdivided samples at all of the other salinities. Christensen (1988) successfully cultured both species at a wide range of salinities and reported gametangia for *V. intermedia* between 0–40.0 ppt and *V. coronata* between 7.5–30.0 ppt. *V. minuta* was identified in all except the 4.0 ppt salinity medium, but this was considered an artifact of data collection as this very delicate species was found in all lower and higher salinities and, because of its size, could easily be overlooked in cultures of mixed species.

Subcultures from the crude samples invariably produced agar-penetrating siphons within the Petri dishes, with excellent growth at all salinities. After more than a week, all of the cultures initiated the production of numerous aplanospores, and many of these quickly germinated *in situ.* In the third or fourth week after inoculation into the agar media, gametangia were finally observed for three species, *Vaucheria arcassonensis, V. compacta,* and *V. coronata.* Because more than one species was found in most of the agar dishes and all three species have overlapping siphon diameters (Blum, 1972), we cannot, therefore, presume that aplanospores were produced by all three species. Christensen (1987), however, reported aplanospores of *V. compacta* forming under culture conditions, yet he rarely collected them in the field together with the identifying gametangia. Christensen also added that asexual spores of *V. arcassonensis* and *V. coronata* were unknown.

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